

AMENDMENTS TO THE SPECIFICATION

Please replace the paragraph bridging pages 1 and 2 with the following new paragraph:

In contrast, a rotary flange 13 is formed on a part of an outer peripheral surface of the hub 8, which is projected from an outer end opening of the outer ring 6 (Here, the outside in the axial direction means the outside portion in the width direction in a fitted state to a car, and corresponds to the left side in respective Figures except FIGS. 2 3, 6, 7, 9, 18. In contrast, the right side in respective Figures except FIGS. 2 3, 6, 7, 9, 18, which is located on the center side in the width direction in a fitted state to a car, is defined as the inside in the axial direction). The wheel 1 and the rotor 2 are coupled/fixed to one side surface (an outer side surface in an illustrated example) of the rotary flange 13 by the studs 9 and nuts 10. Also, an inner ring raceway 14a as the rotary raceway is formed on a middle portion of an outer peripheral surface of the hub 8 to oppose to the outside outer ring raceway 11a out of the double row outer ring raceways 11a, 11b. Then, an inner ring 16 constituting a rotating member 23 as a rotary ring together with the hub 8 is fitted onto a small-diameter stepped portion 15 that is formed on an outer peripheral surface of an inner end portion of the hub 8. Then, an inner ring raceway 14b is formed on an outer peripheral surface of the inner ring 16 as the rotary raceway to oppose to the inside outer ring raceway 11b out of the double row outer ring raceways 11a, 11b. Here, the outer peripheral surfaces of the hub 8 and the inner ring 16 correspond to a rotary peripheral surface set forth in claims.

Please replace the paragraph bridging pages 5 and 6 with the following new paragraph:

Also, in the case of the method of manufacturing the wheel bearing unit set forth in Patent Literature 2, the hub is rotated by the spindle that is inserted into the inside of this hub in the situation that the rotor is fixed to one side surface of the rotary flange provided to the outer peripheral surface of the hub. Then, while rotating the hub, respective portions are finished into predetermined shape and dimension by putting the grinding cutting tool onto both side surfaces of the rotor and a portion of the outer peripheral surface of the hub, onto which the inner ring is fitted. In the case where the wheel bearing unit is manufactured by such method, a perpendicularity of the braking friction surface provided to both side surfaces of the rotor to a center of rotation of the hub can be improved regardless of the dimensional error or the assembling error that is inevitable in manufacturing respective constituent members. Thus, the swing of this rotor can be suppressed to some extent. In this case, as the prior art literatures that are associated with the present invention, there exist Patent Literatures 3 to 8 in addition to above Patent Literatures 1, 2.

Please replace the first full paragraph on page 7 with the following new paragraph:

① Upon grinding or cutting either one side surface of the rotary flange or the braking friction surface of the braking rotation body such as the rotor, or the like couple/fixed to this one side surface to improve a perpendicularity of the braking friction surface of the rotor to the center of rotation of the hub, it is possible that chips as the magnetic material generated by this grinding or cutting adhere to the sensed portion of the encoder. In case the chips adhere in this manner, a sensing performance of the rotation speed sensor becomes worse in the wheel bearing unit into which the rotation speed sensing device is incorporated.

Please replace the paragraph bridging pages 15 and 16 with the following new paragraph:

In above Figures, a reference numeral 1 denotes a wheel, 2 rotor, 3 knuckle, 4 bearing mounting hole, 5 wheel bearing unit, 6, 6a, 6b, 6c outer ring, 7 bolt, 8, 8a, 8b hub, 9 stud, 10 nut, 11a, 11b outer ring raceway, 12, 12a stationary flange, 13 rotary flange, 14a, 14b inner ring raceway, 15 small-diameter stepped portion, 16, 16a, 16b inner ring, 17 ball, 18 cage, 19a, 19b seal ring, 20 spline hole, 21 constant velocity joint, 22 spline shaft, 23, 23a, 23b rotating member, 24 caulked portion, 25 fitting hole, 26 internal space, 27 slinger, 28 encoder, 29 small-diameter stepped portion, 30, 30a to 30f cover, 31 cylinder portion, 32 bottom plate portion, 33 threaded hole, 34 through hole, 35 tentatively setting screw, 36 large-diameter circular cylinder portion, 37 stepped surface, 38, 38a, 38b turning machine, 39 chuck, 40, 40a rotating shaft, 41a, 41b, 41c precision machining tool, 42 ~~core metal~~ reinforcing member, 43 elastic member, 44 fitting portion, 45 through hole, 46 circular ring portion, 47 cylinder portion, 48 curved portion, 49 hydraulic cylinder, 50 fitted cylinder portion, 51 pressing collar portion, 52 projected portion, 53 female spline portion, 54 cylinder portion, 55 latching collar portion, 56 insertion hole, 57 cover, 58 outer-diameter-side cylinder portion, 59 collar portion, 60 inner-diameter-side cylinder portion, 61 stop plug, 62 large-diameter-side cylinder portion, 63 small-diameter- side cylinder portion, 64 stepped portion, 65 bottom plate portion, 66 annular piston, 67 taper portion, 68 lip portion, 69 outer-diameter-side cylinder portion, 70 supporting ring, 71 cylinder portion, 72 encoder, 73 small-diameter stepped portion, 74 cover, 75 main body, 76 fitting cylinder, 77 fitting cylinder portion, 78 inward-directed collar portion, 79 cylinder wall portion, 80 fitting groove, 81 O ring, 82 bottom plate portion, 83 projected portion, 84 insertion hole, 85 holder, 86

inserted portion, 87 fitting flange portion, 88 harness, 89 fitting groove, 90 through hole, 91 core metal, 92 nut, 93 internal thread portion, 94 engaging teeth, 95 circular hole, 96 stop plug, 97 small-diameter cylinder portion, 98 large-diameter cylinder portion, 99 bottom plate portion, 100 projected stripe portion, 101 stepped portion, 102 engaging concave portion, 103 encoder main body, 104 precision machining tool, 105 cylinder portion, 106 small-diameter cylinder portion, 107 large-diameter cylinder portion, 108 encoder, 109 insertion hole, 110 stop plug, 111 fitting portion, 112 stopper portion, 113 knob portion, 114 cylinder portion, 115 bottom plate portion, 116 chamfered portion, 117 small-diameter cylinder portion, 118 large- diameter cylinder portion, 119 stepped portion, 120 bottom plate portion, 121 taper portion, ~~122 projected portion~~, 123 taper portion, 124 threaded hole, and 125 projected portion.

Please replace the paragraph bridging pages 18 and 19 with the following new paragraph:

Also, the rotary flange 13 to which the wheel 1 (FIG.21) constituting the wheel and the rotor 2 as the braking rotation body are fixed is provided to a near-outer-end portion of an outer peripheral surface of the hub 8a, which is projected from an outer end opening of the outer ring 6. A threaded hole 124 is formed at plural locations in the circumferential direction of the rotary flange 13 respectively on the same circumference that has a center of rotation of the hub 8a as its center. Then, thread portions provided to front half portions of a plurality of studs (not shown) can be screwed into these threaded holes 124 respectively. The wheel 1 and the rotor 2 (see FIG.21) are held between head portions provided to based end portions of respective studs and the outer side surface of the rotary flange 13 in the situation that respective studs are screwed into respective threaded holes 124. With this configuration, unlike the case of the conventional

structure shown in above FIG.21, the nuts are not needed to couple/fix the wheel 1 and the rotor 2 to the rotary flange 13 (see Fig. 13). Also, it is possible to prevent the situation that the studs will be a hindrance in the turning operation of the outer side surface of the rotary flange 13 or the outer side surface is distorted when the studs are press-fitted/fixed to the inside of the fitting hole. Also, in the case of this embodiment, an engaged concave portion 102 with which a top end portion of a rotating shaft 40 (FIG.4) of a turning machine 38 described later is engaged is formed on the inside of a center portion of an outer end surface of the hub 8a. This engaged concave portion 102 has a hexagonal cross section and is formed by the forging.

Please replace the paragraph bridging pages 19 and 20 with the following new paragraph:

Meanwhile, an encoder 72 is fitted/fixed onto the inner end portion of the inner ring 16. This encoder 72 has a supporting ring 70 and an encoder main body 103. The supporting ring 70 is formed like an annular ring having an almost T-shaped cross section as a whole by folding a magnetic metal plate such as a SPCC, or the like, and then is fitted/fixed onto the inner end portion of the inner ring 16 as an interference fit. Then, the encoder main body 103 is attached to the inner side surface of the supporting ring 70 by bonding, or the like. This encoder main body 103 is made of a rubber into which ferrite powders are mixed, for example, and is magnetized in the axial direction. Also, the magnetizing direction is changed alternately at an equal interval in the circumferential direction. Thus, the S pole and the N pole are arranged alternately at an equal interval in the circumferential direction on the inner side surface of the encoder main body 103. The reason why the supporting ring 70 is formed to have the almost T-shaped cross section as mentioned above is that magnetized areas of respective magnetic poles

(the N pole and the S pole) of the encoder main body 103 is increased by reducing an inner diameter of the encoder main body 103 smaller than an outer diameter of a shoulder portion of the inner ring 16. Thus, a sensing power of magnetic flux density at the rotation speed sensor using the encoder main body 103 as the sensed portion can be improved because the magnetized areas of respective magnetic poles of the encoder main body 103 are increased.

Please replace the first full paragraph on page 22 with the following new paragraph:

This holder 85 contains the rotation speed sensor in a synthetic resin. This rotation speed sensor consists of an IC into which a magnetic sensing element such as a magnetoresistance element (MR element), or the like whose characteristic is changed in response to a flow direction and magnetic of a magnetic flux and a waveform shaping circuit for shaping an output waveform of this magnetic sensing element are incorporated, a pole piece made of magnetic material to guide the magnetic flux to the magnetic sensing element, and the like. Also, the holder 85 has the inserted portion 86 at its near- top-end portion and a fitting flange portion 87 at its base end portion respectively. A sensing portion of the rotation speed sensor is positioned on the top end surface portion of the inserted portion 86. Also, an end portion of a harness 88 for supplying an output signal, which is output as a shaped waveform from the IC, to a controller (not shown) is connected to the holder 85 directly (without the intervention of the connector, or the like).

Please replace the paragraph bridging pages 25 and 26 with the following new paragraph:

Also, in the case of the present invention, the outer side surface of the rotary flange 13 provided to the outer peripheral surface of the hub 8a is finished into the predetermined shape

and dimension by applying the turning process to this outer side surface in a predetermined state. In other words, when the turning process is applied to this outer side surface, first respective parts of respective constituent members of the wheel bearing unit 5 are processed into the predetermined shape and dimension in the parts maker that manufactures the wheel bearing unit 5, or the like. Then, respective constituent members of the wheel bearing unit 5 are assembled into a state shown in FIG.1 in the parts maker that manufactures the wheel bearing unit 5. In other words, the outer ring 6, the hub 8a, the inner ring 16, and a plurality of balls 17, 17 are assembled together in a condition that a plurality of balls 17, 17 are provided between the outer ring raceways 11a, 11b provided on the inner peripheral surface of the outer ring 6 and the inner ring raceways 14a, 14b provided on the outer peripheral surfaces of the hub 8a and the inner ring 16 respectively. Then, the seal ring 19a is provided between the inner peripheral surface of the outer end portion of the outer ring 6 and the outer peripheral surface of the ~~outer end-middle~~ portion of the hub 8a, and also the encoder 72 is provided onto the outer peripheral surface of the inner end portion of the inner ring 16. Then, the cover 74 is fitted onto the outer peripheral surface of the inner end portion of the outer ring 6, and also the small-diameter cylinder portion 97 of the stop plug 96 is fitted/fixed into the insertion hole 84 provided in the cover 74 to close the insertion hole 84. In this case, an operation to provide the stop plug 96 in the insertion hole 84 may be executed before the cover 74 is fitted to the inner end portion of the outer ring 6. In any event, the space in which the encoder 72 is provided can be isolated from the outside in the state that the insertion hole 84 is closed by the stop plug 96.

Please replace the paragraph bridging pages 29 and 30 with the following new paragraph:

Next, FIGS.5 to 7 show a second embodiment of the present invention, which also corresponds to claims 1, 3, 4, and 6. A wheel bearing unit of the present embodiment is used to bear the wheel that is used as the driven wheel, unlike the case of the above first embodiment. For this purpose, the spline hole 20 that passes through the hub 8 in the axial direction is formed at the center portion of the hub 8. Also, in the case of the present embodiment, the inner ring 16 is fitted/fixed onto the inner end portion of the hub 8 by means of the interference fit that generates a larger immobile force than an axial force generated based on the preload applied to respective balls 17, 17, or the like. Also, an encoder 108 is fitted/fixed onto a part of the outer peripheral surface of the middle portion of the hub 8, which is located between the inner ring raceway 14a formed on the outer peripheral surface of the hub 8 and the inner ring 16, by means of the interference fit. This encoder 108 is constructed by fitting/fixing an encoder main body formed like a circular cylinder onto an outer peripheral surface of a ~~core metal reinforcing member~~ formed also like a circular cylinder. The ~~core metal reinforcing member~~ is made of a magnetic metal plate such as a mild steel plate like SPCC, or the like and formed also like a circular cylinder. Also, the encoder main body is made of a rubber into which ferrite powders are mixed, for example, and is magnetized in the diameter direction. The magnetized direction is changed alternately at an equal interval in the circumferential direction. Thus, the S pole and the N pole are arranged on an outer peripheral surface of the encoder 108 alternately at an equal interval in the circumferential direction.

Please replace the paragraph bridging pages 30 and 31 with the following new paragraph:

Then, an insertion hole 109 is formed in the middle portion of the outer ring 6 in the axial direction, which is located in a discontinuous portion of the stationary flange 12 in the circumferential direction, in a state that such insertion hole passes through the outer ring 6 from the outer peripheral surface to the inner peripheral surface in the radial direction. A rotation speed sensor (not shown) can be inserted into the inner side of this insertion hole 109. In operation of the wheel bearing unit, the rotation speed sensor is inserted into this insertion hole 109 and fixed thereto in such a manner that a sensing portion provided to a top end surface of the rotation speed sensor is positioned to oppose to the outer peripheral surface of the encoder 108 via a small clearance. Here, preferably the insertion hole 109 should be formed in the neighborhood of the horizontal area of the outer ring 6 is a fitted state of the wheel bearing unit to a suspension. The reason for this is that, if the insertion hole 109 is formed in the area to which the load is most hard to be applied, the influence of formation of the insertion hole 109 on a strength reduction of the outer ring 6 can be suppressed to the lowest minimum. Also, out of opening portions on both ends of the insertion hole 109, an opening portion formed on the inner peripheral surface side of the outer ring 6 is opposed to a sensed portion of the encoder 108, i.e., the outer peripheral surface of the encoder 108. Also, out of the opening portions on both ends of the insertion hole 109, a stop plug 110 is detachably attached to the opening portion formed on the outer peripheral surface side of the outer ring 6.

Please replace the paragraph bridging pages 36 and 37 with the following new paragraph:

Next, FIGS.8 and 9 show a third embodiment of the present invention, which also corresponds to claims 1, 3, 4, and 6. In the case of the present embodiment, unlike the case of

the second embodiment shown in above FIGS.5 to 7, the inner end surface of the inner ring 16 that is fitted onto the inner end portion of a hub 8b is held by the caulked portion 24 that is formed by plastically deforming the cylinder portion 71, which is provided to the inner end portion of the hub 8b, outward in the diameter direction by means of the caulking. Also, in the case of the present embodiment, unlike the case of the second embodiment shown in above FIGS.5 to 7, the encoder is not fitted onto the outer peripheral surface of the hub 8b. Also, the insertion hole, which passes through in the diameter direction and through which the rotation speed sensor can be inserted, is not formed in the middle portion of the outer ring 6 in the axial direction. Alternately, in the case of the present embodiment, an encoder 28 is fixed to a part of the seal ring 19b that is provided between the inner peripheral surface of the inner end portion of the outer ring 6 and the outer peripheral surface of the inner end portion of the inner ring 16. In other words, this seal ring 19b consists of a slinger 27 that is formed as an annular ring as a whole to have an L-shaped cross section and fitted/fixed onto the inner end portion of the inner ring 16, a ~~core metal-reinforcing member~~ 42 that is formed as an annular ring as a whole to have an L-shaped cross section and fitted/fixed into the inner end portion of the outer ring 6, and an elastic member 43 a base end portion of which is coupled/fixed to the ~~core metal-reinforcing member~~ 42. Also, a top end edge of the seal lip constituting the elastic member 43 is brought into contact with the outer peripheral surface and the outer side surface of the slinger 27 to slide thereon.

Please replace the first full paragraph on page 41 with the following new paragraph:

Also, in the case of the present embodiment, the fitted cylinder portion 50 of the cover 30 is fitted/fixed into the inner end portion of the spline hole 20 via a plurality of projected portions

52, 52 during the turning process applied to the outer side surface of the rotary flange 13. For this reason, a dimensional tolerance of the inner diameter of the inner end portion of the spline hole 20 can be set large like about 0.2 mm, and also the fitted cylinder portion 50 can be detachably attached easily to the spline hole 20 by a small force even when the inner diameter of the inner end portion of the spline hole 20 is processed smaller than a normal dimension.

Please replace the second full paragraph on page 55 with the following new paragraph:

Next, FIGS.15 and 16 show an eighth embodiment of the present invention, which also corresponds to claims 2, 3, 5, and 6. In the case of a wheel bearing unit of the present embodiment, unlike the case of the seventh embodiment shown in above FIGS.13 and 14, the core metal-reinforcing member 42 (see FIG.13) to which the elastic member 43 is coupled is not fitted/fixed into the inner end portion of the outer ring 6. Therefore, no seal ring is present between the inner peripheral surface of the inner end portion of the outer ring 6 and the outer peripheral surface of the inner end portion of the inner ring 16.

Please replace the paragraph bridging pages 58 and 59 with the following new paragraph:

Also, in the case of the present embodiment, because the core metal-reinforcing member 42 (see FIG.13, etc.) to which the elastic member 43 is coupled is not fitted/fixed into the inner peripheral surface of the inner end portion of the outer ring 6, no seal ring is present between the inner peripheral surface of the inner end portion of the outer ring 6 and the outer peripheral surface of the inner end portion of the inner ring 16. In operation of such wheel bearing unit of

the present embodiment, the wheel bearing unit 5 is fitted to the knuckle 3 and also the spline shaft 22 (see FIG.21) constituting the constant velocity joint 21 is inserted into the spline hole 20. Then, in this condition, a sealing structure is provided between a part of the constant velocity joint 21 and the inner end portion of the knuckle 3. With such arrangement, although no seal ring is present between the inner peripheral surface of the inner end portion of the outer ring 6 and the outer peripheral surface of the inner end portion of the inner ring 16, the space in which the encoder 28 is provided can be sealed tightly from the outside. Also, in this case, the sensing portion of the rotation speed sensor opposing to the encoder 28 can be sealed tightly from the outside.

Please replace the paragraph bridging pages 62 and 63 with the following new paragraph:

Also, in the case of the present embodiment, the fitted cylinder portion 50 of the cover 30e is fitted/fixed into the inner end portion of the spline hole 20 via a plurality of projected portions 52, 52 during the turning process applied to both side surfaces of the rotor 2. Therefore, a dimensional tolerance of the inner diameter of the inner end portion of the spline hole 20 can be set large like 0.2 mm. Thus, even when the processed inner diameter of the inner end portion of the spline hole 20 is formed smaller than a normal dimension, the fitted cylinder portion 50 can be detachably attached easily to the spline hole 20 by a small force.

Please replace the paragraph bridging pages 63 and 64 with the following new paragraph:

Next, FIG.19 shows a tenth embodiment of the present invention, which also corresponds to claims 2, 3, 5, and 6. In the case of the present embodiment, an insertion hole 56 that passes through from the outer peripheral surface to the inner peripheral surface is formed in a part at a circumferential section of a stationary flange 12a provided to the outer peripheral surface of the inner end portion of an outer ring 6b. In operation of the wheel bearing unit, a circular cylinder portion constituting the rotation speed sensor (not shown) is inserted into the inside of the insertion hole 56. Also, in the case of the present embodiment, when the turning process is applied to both side surfaces of the rotor 2 (see FIG.14, etc.), the outer peripheral surface of the caulked portion 24 provided to the inner end portion of the hub 8b is isolated from the inner peripheral surface of the inner end portion of the outer ring 6b by a cover 57 and also the insertion hole 56 is closed by a stop plug 61. The cover 57 is formed like an annular ring as a whole to have an almost \square -shaped cross section. Also, a collar portion 59 formed like the outward-directed flange is provided to a top end edge portion of an outer-diameter-side cylinder portion 58 constituting the cover 57. Such cover 57 is fitted to the hub 8b by fitting an inner-diameter-side cylinder portion 60 provided to the inner peripheral edge portion into the inner end portion of the hub 8b before the turning process is applied to both side surfaces of the rotor 2. In this state, the outer peripheral edge of the collar portion 59 provided to the cover 57 is opposed closely to the inner peripheral surface of the inner end portion of the hub 8b-outer ring 6b via a small clearance and the outer side surface of the collar portion 59 is opposed closely to the inner side surface of the encoder via a small clearance. Then, the space in which the encoder 28 is provided is isolated from the outside.

Please replace the paragraph bridging pages 64 and 65 with the following new paragraph:

In the case of the present embodiment constructed as above, because the insertion hole 56 provided to a part of the outer ring 6 6b is stopped by the stop plug 61 during the turning process applied to both side surfaces of the rotor 2, it can be prevented that the chips generated in the turning process enter into the space, in which the encoder 28 is provided, through the insertion hole 56. As a result, not only the space between the inner peripheral surface of the inner end portion of the outer ring 6 6b and the outer peripheral surface of the inner end portion of the hub 8b can be closed by the cover 57 but also the adhesion of the chips onto the inner side surface of the encoder 28 can be prevented, so that an improvement of a sensing performance of the rotation speed sensor that is opposed to the encoder 28 can be achieved.

Please replace the paragraph bridging pages 65 and 66 with the following new paragraph:

In such configuration of the present embodiment, the operation of applying the turning process to both end surfaces of the rotor 2 (see FIG.14, etc.) is performed as follows. That is, first respective constituent members of the wheel bearing unit before the rotor 2 is coupled are assembled and also the portion of the rotor 2 near the inner diameter is coupled/fixed to the outer side surface of the rotary flange 13 provided to the outer peripheral surface of the outer end portion of the outer ring 6c. Also, a cover 30f is fitted/fixed onto the inner end portion of the outer ring 6c. The cover 30f is formed like an annular ring as a whole to have an almost \square -shaped cross section, and a lip portion 68 is provided to its inner peripheral edge portion. Then,

an outer-diameter-side cylinder portion 69 constituting the cover 30f is fitted/fixed onto the small- diameter stepped portion 29 provided to the inner end portion of the outer ring-6b 6c. Also, a top end edge of the lip portion 68 provided to the cover 30f is pushed against the inner end surface of the inside inner ring 16b out of a pair of inner rings 16a, 16b. In this state, the space in which the encoder 28 is provided is isolated from the outside of the cover 30f. Then, in this condition, the wheel bearing unit with the side surface of the rotor 2, to which the turning process is applied, is fitted to the turning machine (not shown). Also, the rotating shaft coupled to the end portion of the chuck is turned in a state that a pair of inner rings 16a, 16b are fitted/fixed onto the fixed supporting shaft constituting the turning machine and also the portion of the outer peripheral surface of the outer ring 6c near the inner end, which is deviated from the portion onto which the cover 30f is fitted, is clamped by the chuck of the turning machine. Then, in this condition, the turning process is applied to both side surfaces of the rotor 2 near the outer diameter by putting the precision machining tool to these surfaces, and thus both side surfaces are finished into the predetermined shape and dimension. In the case of the wheel bearing unit manufactured in this manner, a sensing performance of the rotation speed sensor (not shown) that is faced to the encoder 28 can be assured sufficiently, and also the swing of the braking friction surface provided to both side surfaces of the rotor 2 can be suppressed satisfactorily.